Utilization of Marine Fungi as a Feed Additive on the Performance of Local Chickens' Digestive Organs

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Abstract. This study aimed to evaluate the utilization of marine fungi as feed additives on the performance of local chickens' digestive organs. This study used one hundred and eighty local chickens aged one day which were kept for 10 weeks and divided into five treatment groups and four replications. Chickens consumed treatment diets containing yellow maize, rice bran, soybean meal, fish meal, coconut meal, L-lysine, methionine, $CaCO_3$, and added marine fungi. Chickens were slaughtered at 10 weeks old and digestive organs (liver, ventriculus, and small intestine) were collected and weighed to measure digestive organs' performance. Data were analyzed by analysis of variance by a completely randomized design. An orthogonal contrast test analyzed the significant effects of treatment diets on the parameters. This study showed that marine fungi significantly decreased feed consumption ($P<0.05$) without any declining digestive organ performance. It is suggested to add marine fungi extract to the local chicken diet as much as a 2 ml/kg ration.

1 Introduction

The performance of digestive organs in chickens such as the gizzard, pancreas, liver, and small intestine is highly influenced by the quality of feed. Feeding with poor quality feed such as containing high crude fiber will make poultry digestive organs work harder to digest the fiber so that there will be thickening of the organs or enlargement of the size and in the end an increase in the organ's weight. This is due to poultry having limited digestive enzymes to digest fiber. Poultry also does not produce cellulase enzymes used to digest cellulose. Feedstuff sources from plants have limitations such as high crude fiber content and there is

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also an anti-nutrition that can inhibit the digestive process of food ingredients and the absorption of food substances.

A healthy digestive tract is characterized by the development of the weight and length of the optimal digestive tract [1], which will have an impact on the ability of livestock to absorb food substances and increase growth, carcasses, and organs. Good nutritional absorption will help increase the chicken's performance [2]. Optimizing the performance of the broiler small intestine, helping the process of digestion and absorption of nutrients, and improving chicken growth might be added feed additive into the ration.

Feed additive is a substance that does not include feed that is added in small amounts and aims to increase feed efficiency, chicken growth, improve the chicken's health, and produce healthy products, thus, the products are safe for consumption by the community [3]. The use of synthetical feed additives in the ration might result in feed additive residue in poultry products such as eggs and meat [4, 5, 7] so that they become unsafe for consumption and could endanger consumers' health if they consume them continuously for a deeply long period [8]. In addition, the use of antibiotics in animal feed, especially poultry, has been banned by the Indonesian government with the issuance of Law Number 18 of 2009 Juncto Number 41 of 2014 concerning Animal Husbandry and Health, The Minister of Agriculture Regulation No. 14 of 2017 concerning Classification of Animal Medicines.

Natural feed additives such as herbs contain active compounds that might be used as toxicity, antimicrobial agents, antifoaming, etc. One natural feed additive is marine fungi which contains 82 active compounds [9]. Recently, many studies about marine fungi have focused on the identification of the active compounds produced by marine fungi and their activities as antifungal and antibacterial [10, 11], antiviral [12], antioxidant [13], and cytotoxic activities [14]. Therefore, is expected to minimize the formation of residues in livestock products due to the use of synthetic additives in the ration and improve the performance of digestive organs without any interference with the work of digestive organs so that feed digestion and nutrient absorption might be done optimally to improve chicken performance. However, until now, there has been no report on the use of marine fungi either as feedstuff or feed additives in poultry, thus, this study could be significant as basic data for further research.

2 Materials and methods

This research was conducted at the Laboratory of Animal Science and Forage Production, Faculty of Animal Science, University of Jambi using 180 one-day-old local chickens under the supervision of the Department of Animal Health, Faculty of Animal Science, University of Jambi. The nutrient composition of feedstuffs was analyzed in the Laboratory of Feed Science and Technology, Faculty of Animal Science, IPB University. Basal and treatment rations were composed of yellow maize, rice bran, fish meal, soybean meal, coconut meal, L-lysine, methionine, and $CaCO_3$ as shown in Table 1.

Marine fungi extract as a treatment obtained from the Faculty of Fisheries and Marine Sciences, IPB University. Feed and drinking water were provided ad libitum, and chickens accessed free feed and drinking water during the feeding trial period for 10 weeks. Each cage contained nine chickens that were placed randomly into the cage. The cage was equipped with feeders, drinking water bottles, scales, and lights with 25 watts of power for 2 weeks keeping and then after it was lighting with 5 watts. Every 2 weeks, feed consumption was measured by calculating the difference between the feed provided and the remaining feed, and expressed in g/head/week. At the end of the experiment, after 10 weeks of keeping, forty chickens were slaughtered and the digestive organs (pancreas, liver, and gizzard) were collected to measure the organs' weight. The digestive organs were compared to slaughtered weight to get the digestive organ percentage. The treatments in this study were T0: basal

ration without any addition of marine fungi extract, T1: basal ration + 1 ml marine fungi/kg ration, T2: basal ration + 2 ml marine fungi/kg ration, T3: basal ration + 3 ml marine fungi/kg ration, and T4: basal ration + 4 ml marine fungi/kg ration.

Table 1. The feedstuffs and nutrient composition of basal ration.

Feedstuff	Percentage	Nutrients (%)	Percentage
Yellow maize	40	Dry matter	85.45
Rice bran	21	Organic matter	72.88
Fish meal	15	Crude protein	26.32
Soybean meal	10	Crude fiber	9.78
Vegetable oil	2	Crude fat	11.05
Coconut meal	10	Nitrogen free extract	27.73
L-Lysine	0,5	Gross energy (Kcal/kg)	3598.29
Methionine	0,5		
$CaCo_3$	1		
Total	**100**		

2.1 Statistical analysis

Data of measured parameters were analyzed using One-way ANOVA procedures of Analyse-it which was integrated in Microsoft Excel for Windows part of Microsoft Office Home and Students 2021. Identification of any significant effect on the parameter was tested by Duncan's Multiple Range Test with a Confidence level of 95% ($\alpha = 0.05$).

3 Results and discussion

The effect of treatments on the measured parameter (feed consumption, slaughtered weight, the percentage of pancreas, liver, and gizzard) is shown in Table 2. Generally, adding marine fungi extract into the ration did not significantly affect the performance of the digestive organs of local chicken after rearing for 10 weeks. However, it affected the feed consumption and chicken decreased their consumption in line with to increase in the level of marine fungi extract in the ration.

3.1 Feed consumption

Table 2 showed that the feed consumption among the treatment group of chickens fed a ration containing marine fungi extract significantly decreased ($P<0.05$) in line with the increased level of marine fungi extract in the ration. However, the feed consumption among groups of chicken fed the ration containing marine fungi extract of 1 - 4 ml/kg was significantly similar ($P>0.05$), even though it tended to increase when marine fungi extract was added more then 2 ml/kg of ration. It is indicated that the active compounds in marine fungi such as β-glucan, alkaloids, terpenoids, peptide derivatives, phytosterols, polyphenols, saponins, and polysaccharides [15, 16] play an important and significant role on nutrient digestion in chicken. These active compounds can increase the growth of good bacteria in the digestive

tract so that digestive health can be maintained and feed intake might be reduced. Besides, they have bulky properties that will slow the digestion of carbohydrates and the rate of nutrients in the digestive tract. Thus, the chicken will be easily full and temporarily stop consuming feed. The chicken will re-consume when it is hungry.

The feed consumption of local chicken for 10 weeks in this study was around 328 – 362 g/head /week (Table 2), which was lower than that reported by previous researchers who found that local chicken consumed feed around 350-357 g/head/week when they were reared for 8 weeks [17] and super local chicken consumed feed more than 400 g/head/week after feeding a feed containing chicory flour for 7 weeks of rearing [18]. The current study indicated that marine fungi extract might be added to the ration of local chicken to improve feed efficiency and reduce production costs because feed cost is more than 70% of production cost. In addition, the availability of energy and protein in the ration (Table 1) that exceeds the chicken's need will also affect the consumption of rations which ultimately affects the chicken's weight when it is slaughtered. Chicken to grow requires 24% protein and metabolic energy of 3200 kcal/kg [19]. Chicken eats to meet energy needs, when energy needs are met, the chicken will stop eating.

Table 2. Effect of addition of marine fungi extract into the rations on feed consumption, slaughtered weight, and digestive organs performance of local chicken (mean±SD).

Parameters	Treatment				
	T0	T1	T2	T3	T4
Feed consumption (g/head/week)	362.00±14.91^{a}	343.58±5.41^{ab}	328.43±12.92^{b}	331.47±13.45^{b}	333.65±16.55^{b}
Slaughtered weight (g/head)	668.75±62.10	727.50±43.49	733.75±74.76	725.00±74.27	657.50±73.99
Pancreas (%)	0.26±0.06	0.26±0.06	0.28±0.05	0.27±0.02	0.29±0.02
Liver (%)	2.15±0.32	2.16±0.18	2.32±0.40	2.07±0.22	1.96±0.12
Gizzard (%)	2.56±0.36	2.68±0.24	2.50±0.28	2.75±0.23	2.56±0.22

Different superscripts on the same row showed significantly different ($P<0.05$)

3.2 Slaughtered weight

Table 2 shows that the slaughtered weight of chickens fed a ration either with or without adding marine fungi extract was not different statistically. Analysis of the variance of the slaughtered weight of local chicken after feeding ration containing marine fungi extract up to 4 ml/kg ration for 10 weeks did not significantly ($P>0.05$) affect the slaughtered weight of chicken. however, the weight tended to decrease with the increased amount of adding marine extract fungi to the ration. This is not in line with the feed consumption data where consumption increases when marine fungi are given more than 2 ml/kg of rations.

The slaughtered weight produced in this study was higher than that reported by Sari [20] who reported that the slaughtered weight of local chickens that were kept for 7 weeks ranges from 402-529 g/head, whereas, the slaughtered weight of local chicken in the present study was around 657 - 727 g/head. It indicated that marine fungi have a positive effect on increasing the body weight of local chicken, therefore, it might be used as a feed additive.

Referring to the slaughtered weight data shown in Table 2, generally, the addition of marine fungi did not affect the slaughtered weight but the addition of more than 2 ml/kg of rations resulted in a decrease in slaughtered weight. This might be due to the phytochemical

content and secondary metabolite of marine fungi such as phytosterol, polyphenol, β-glucan, and saponin [16, 21, 22] which makes feed less consumed, thus, the body weight produced decreased. Tanti et al. [23] reported that slaughtered weight was highly affected by feed consumption, feed quality, and the addition of natural feed additives into the ration. Using a small amount of natural feed additives such as curcuma and black garlic would not interfere with the feed consumption, the body weight of broiler chicken, slaughtered weight, and carcass percentage. In addition, marine fungi extract did not change the nutrient content in the feed, especially protein and energy.

3.3 Digestive organs performance

The results of the variance analysis showed that the addition of marine fungi into the ration up to 4 ml/kg ration did not affect (P>0.05) the weight of the digestive organs both pancreas, ventriculus, and liver (Table 2). These results showed that the content of active compounds and secondary metabolites in marine fungi such as polyphenol, β-glucan, and saponins, did not cause digestive organs to work harder in digesting the feed consumed, thus, the organs become healthier and could digest and absorb nutrients well. Pertiwi et al., [1] stated that the digestive tract was a vital organ for digesting ration and absorbing nutrients. Nutrient absorption in the intestine takes place optimally if the intestine is in a healthy condition which is marked by the growth and development of small intestine villi-villi [24]. The height of the villi and depth of the small intestinal cript will increase the surface area of the intestine thereby expanding the absorption area and increasing the ability to absorb nutrition.

The pancreas weight in this study was 0.26 – 0.28% of the chicken's body weight which was similar to the previous study [25] found that the pancreas weight of chicken was around 0,26-0,29%. It indicated that marine fungi in the ration did not cause damage to the structure and performance of the pancreas, thus, it can carry out its functions in the digestive system and metabolism of nutrients, endocrine and exocrine functions, and produce the enzymes needed to digest food. Table 2 showed that the pancreas weight tended to increase in line with the increasing level of marine fungi extract addition but it was still in normal weight.

The liver weight found in this study was not different among the treatment group of chickens fed ration containing marine fungi extract of 0 – 4 ml/kg. The present study found that the liver weight was 1.96-2.32% of body weight. The weight of the liver tended to decrease with increasing levels of using marine fungi extract in the ration even though it was still within normal limits. These weights were quite similar to those reported by previous researchers [25, 26] but lower than those reported by Maradon et al. [27] who found that the liver weight of chicken was around 2.80 – 3.34% of body weight. Lestari et al. [25] found that the liver weight of chicken was 2.31-2.57% of body weight. Lutfan et al. [26] reported that the liver weight of broiler chicken at 35 days old was 1.69-2.01% of body weight.

Enlargement of the liver can occur if the feed consumed contains high crude fiber and causes an increase in liver weight. in this study, the ration contained 9.78% crude fibre (Table 1). It indicated that local chicken more tolerates the high crude fiber content than broiler chicken and that its ability to digest crude fiber is less than 6% in the ration.

Analysis of variance showed that the gizzard weight in the present study was not influenced significantly by the treatments (Table 2, P>0.05) and their weight was still in a normal condition which was 2.50-2.75% of the slaughtered weight. It was higher that that previous studies reported by Lutfan et al. [26] who found the gizzard weight was 1.28-1.44%. Lestari et al. [25] found that the gizzard weight was 1.49-1.65%. the result of this study was lower than that reported by Maradon et al. [27] who found the gizzard weight of male chicken strain ISA brown at 8 weeks old was 3.39 – 4.57%. Differences in the gizzard weight produced in this study with other studies might be due to differences in the given feed quality, feed form, the age of the chicken, and the strain of the chicken used. Gizzard in chickens

plays a very important role in the digestion process of food due to the absence of teeth in chickens so that there is no process of digesting food in the mouth. Mechanical digestion in poultry occurs first in the gizzard. The feed containing high crude fiber will make the gizzard require more energy to digest it so that the gizzard wall will thicken and as a result, the gizzard weight will increase.

4 Conclusions

Based on the results of this study, it is concluded that marine fungi might be added to the ration up to 4 ml/kg ration of local chicken without any declining digestive organ performance. However, it is suggested to add marine fungi extract to the local chicken diet as much as a 2 ml/kg ration to get a better performance.

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